**Unit Plan**

**Logistics information:**

1. Grade level: 11
2. Course Name: Chemistry
3. Instructor: Mr. V.B. Ndaba

**Background Information:**

This classroom comprises of a diverse group of individuals. A bunch of them do not have the basic understanding of general chemistry. These learners need to be encouraged to participate in class discussions as you will see that they lack this characteristic. You have to cope with their social problems they face at home. However, they have basic knowledge of the periodic table and having reviewed their grade 10 work, they can balance chemical equations fairly well. However, we have English Language Learners that have not reached the expected level of English proficiency and in abstract situations; they will need someone who is able to differentiate instruction for them.

Unit Name: introduction to stoichiometry and related concepts

Approximate Length: 10days

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| **Enduring Understanding (s): students will understand that using mathematics; someone can determine the quantities of particular elements needed to create a desired reaction, or the quantities used in the generation of a reaction which has already occurred. They will also differentiate between various chemical reactions by practical means.** | |
| **Essential Question (s):**   * What is stoichiometry? * What is a mole? * What is a molar mass? * What is a theoretical yield? * What is a percent yield? * What is chemical reaction? * What is a concentration? | |
| **Content:**  **Students will know:**  **Unit 1:**   * **Stoichiometry** is simply the math behind chemistry. Given enough information, one can use stoichiometry to calculate masses, moles, and percents within a chemical equation. * **A mole** is the amount of a substance that contains as many atoms, molecules, ions, or other elementary units as the number of atoms in 0.012 kilogram of carbon 12. The number is 6.0225 × 1023 * **Molar mass**, symbol *M*r is the mass of one mole of a substance (chemical element or chemical compound). * **Theoretical yield** amount of product that can be produced when all of the limiting reactant is used. * **Percent yield** is defined as a way of measuring how successful a reaction has   been.  **Unit 2:**   * **Chemical reactions:** Interaction of two or more chemicals that [produces](http://www.businessdictionary.com/definition/produce.html) one or more new chemical [compounds](http://www.businessdictionary.com/definition/compound.html), or alters the [properties](http://www.businessdictionary.com/definition/property.html) of the mixed chemicals. One can use experimental evidence to prove the existence of these chemical reactions. * **addition/ combination/ synthesis:** two or more simple compounds combine to form a more complicated one * **decomposition:** opposite of a synthesis reaction - a complex molecule breaks down to * **Precipitation:** soluble ions in separate solutions are mixed together to form an insoluble compound that settles out of solution as a solid. That insoluble compound is called a precipitate * **acid-base:** special kind of double displacement reaction that takes place when an acid and base react with each other * **single replacement:** element trades places with another element in a compound * **double replacement:** anions and cations of two different molecules switch places, forming two entirely different compounds * **decomposition:** opposite of a synthesis reaction - a complex molecule breaks down to make simpler ones * **Combustion:** oxygen combines with another compound to form water and carbon dioxide. These reactions are exothermic, meaning they produce heat * **Concentration/ Molarity (M)**   **Molarity**: number of moles of solute per liter of solution (not necessarily the same as the volume of solvent!).  **Solution:** a homogeneous [mixture](http://chemistry.about.com/od/dictionariesglossaries/g/defmixture.htm) of two or more substances. Can’t separate the substances using physical techniques. | **Skill (s):**  **Students will be able to:**   * Explain the importance of stoichiometry to chemists. * Do mass-mole calculations. * Calculate the percent yield of a reaction.   **Skill (s):**  **Students will be able to:**   * Name chemical reactions. * Wright net ionic equations. * Calculate concentration of a solution. |
| **Assessment (s):**  **Unit one:**   * Reflection showing an importance of stoichiometry to chemical industries. * Quiz on mass-mole calculations and theoretical yield. * Lab practical on percent yield.   **Unit two:**   * Lab safety (MSDS) * Lab experiments. * Reflection on the importance of practical work. * Quiz on naming different kinds of chemical reactions. | |
| **Additional Resources:**   * <http://docs.google.com/viewer?a=v&q=cache:ZieqiateBjwJ:www.bernard.p.sardissecondary.ca/files/experiment%25205%2520-%2520determining%2520percent%2520yield%2520in%2520a%2520chemical%2520reaction.pdf+lab+practical+on+percent+yield&hl=en&gl=za&pid=bl&srcid=ADGEEShyHbEQSxjMn56_f9bGBW6rIgSy6VO698ayLQ20O3N005KjlLI3VkFNeFaG5SZh4q0irDxb4lGZpukIOkTC9azL_M6CoyvnA5jK89xLdCyg-blPNxjbFf9aORk1mFhhLOcH0cft&sig=AHIEtbTuGtRhyvjfomIYiVlvO5K_RMoqvg> * <http://www.sciencebugz.com/chemistry/chsolstoich.htm> * <http://www.cartage.org.lb/en/themes/sciences/chemistry/miscellenous/helpfile/stoichiometry/percentyield.htm> * <http://chemistry.bd.psu.edu/jircitano/mole.html> * <http://www.businessdictionary.com/definition/chemical-reaction.html> * <http://misterguch.brinkster.net/6typesofchemicalrxn.html> * <http://docs.google.com/viewer?a=v&q=cache:HsLlEiIEKNgJ:138.47.34.142/moodle/chem100/groupactivity/Ch5-Chemical%2520Reactions%2520in%2520Solutions.pdf+number+of+moles+of+solute+per+liter+of+solution+(not+necessarily+the+same+as+the+volume+of+solvent!).&hl=en&gl=us&pid=bl&srcid=ADGEESg148RzOb5NETJYCL7Dhvsqk8JxOrV_7A34qVy-uiv6YssROjrR-pYxpEgevFREgE41mG9E_65rHce-4DnlXoBqYCbGosDNlRnNUntwNyYRbCgwGJJtuW_dXTzCAB970c4N6iBb&sig=AHIEtbQ7t6LHXykwvalxTqCX3EMoJZNHiw> | |

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| **Day 1** | | | |
| **Phase of the lesson** | **Goal for the Activity** | **Description of Learning Activity** | **Evidence of Student Understanding** |
| **Engage**: what is stoichiometry?-5 min.  **Explore:** why is stoichiometry important to chemists. (discuss)-10min  **Explain:** explain the relationship between the given mass of an atom and its molar mass.-5min  **Elaborate**: how is an Avogadro’s constant related to the mole concept?-10min  **Evaluate:** Calculate the number of moles in: 1.00g of water (H2O, *M*r =18.02g). what if you were given 0.124 moles of sulphur, how would you calculate its mass?-10min  **Wrap up**-10min. | 1. Learners will understand the importance of stoichiometry to chemists. 2. Learners will be able to do mass ↔ mole conversions. | Before the lesson starts, learners will be given some few minutes to write down what they know and what they expect to know about stoichiometry. During the lesson, Learners will be working in pairs. Individually, they will have to do activities involving massmole conversions-10min. Total Time for the lesson is 60min. | 1. Understanding based on their responses. 2. Understanding based on their answers. 3. Students will compute the relationship by using the equation n = mass ÷ MM. 4. They will tell me why we include an Avogadro’s constant to the mole concept. 5. They will tell me how to calculate the number of moles and/ mass of a compound/ element. |

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| **Day2** | | | |
| **Phase of the lesson** | **Goal for the Activity** | **Description of Learning Activity** | **Evidence of Student Understanding** |
| **Engage:** in your own words, try and define limiting and excess reactant-5min  **Explore:** imagine a company has 8 car bodies and 48 tires. How many cars do you think will be manufactured-5min  **Explain:** explain the above reasoning in terms of limiting and excess reactants-10min  **Elaborate:** without any further calculation, identify the limiting and excess reactants when 0.5 mol Zn react completely with 0.4 mol HCl-5min  **Evaluate:** when there said to have been an excess reactant in a reaction, what does that mean?-10min  **Wrap up:** 10min | 1. Learners will understand the concepts; limiting and excess reactants in a chemical reaction. 2. Learners will use stoichiometry to calculate the limiting and excess reactants. | **Discussion:** Find the limiting reagent and the reactant in excess when 1.5g of CaCO3 reacts completely with 0.73g of HCl-10min. ELL’s will work with more proficient English speakers. Time for the lesson is 50min. | 1. Understanding will be based on their language reflection. 2. Understanding will be based on their answers. 3. Understanding will be based on the definition of limiting and excess reactant. 4. Understanding comes from their responses. 5. Understanding comes from examples they will give me. |

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| **Day3** | | | |
| **Phase of the lesson** | **Goal for the Activity** | **Description of Learning Activity** | **Evidence of Student Understanding** |
| **Engage:** what is a theoretical yield?-5min  **Explore:** with your friend, compare theoretical yield and actual yield in your own words-10min  **Explain:** why in your own opinion do you think chemists use the limiting reactant and not the excess to figure out the theoretical yield?-10min  **Elaborate:** Given the following reaction of methane with oxygen, determine the theoretical yield of  water if you have 24.0 gram CH4 and 48.0 gram O2.  CH4 + 2 O2  → CO2  + 2 H2O. First check which chemical is a limiting reactant (theoretically or by inspection) and with it, find the theoretical yield-20min  **Evaluate:** I would like you to check how friends from other groups are doing it and talk to each other-5min  **Wrap up:** first check that your chemical equation is balanced before proceeding with these problems-5min | 1. Learners will be able to calculate the theoretical yield in a chemical reaction. | Learners will be given a combination reaction similar to the one they dealt with during the lesson, and use the given data to calculate the theoretical yield. Overall time=55min. | 1. Correct usage of the language. 2. Correct usage of the language. 3. Common sense usage. 4. Understanding comes from correct usage of formulae ability to represent stoichiometric ratios between chemicals. 5. They will show understanding when they are able to interpret a similar problem. |

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| **Day4** | | | | |
| **Phase of the lesson** | | **Goal for the Activity** | **Description of Learning Activity** | **Evidence of Student Understanding** |
| **Engage:** why do chemists worry about the percent yield of a reaction?Discuss-10min  **Explore:** What is the percent yield of the following reaction if 60 grams of CaCO3 is heated to give 15 grams of CaO?   |  | | --- | | CaCO3→CaO + CO2 |   -use the formula: Percent Yield =  http://www.iun.edu/~cpanhd/C101webnotes/quantchem/images/pctyld.jpg  **Explain:** explain the consequence if the company gets a percent yield less than 50% of the manufactured product-10min  **Elaborate:** 50 g of silver nitrate is mixed with 50 g of hydrochloric acid in a water based solution. A white precipitate forms (silver chloride). The solution is filtered and the white precipitate collected and dried. The dried precipitate is measured to have a mass of 53.6 g. What is the theoretical and percent yield?-20min  **Evaluate:** if you are given the percent yield and the theoretical yield, how can you figure out the actual yield?  **Wrap up:** 5min | Learners will be able to calculate the percent yield of a chemical reaction. | | Learners need to demonstrate the skill of finding the percent yield and so they will be given a detailed problem which suggests steps for them like we have been doing in our lesson. ELL’s work with more proficient English speakers.  Total time= 50min | 1. Understanding is based on their answers. 2. Understanding comes from the correct procedures they take. 3. Understanding will come from their thought. 4. Correct usage of procedures. 5. Correct math manipulation. |

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| **Day5** | | | |
| **Phase of the lesson** | **Goal for the Activity** | **Description of Learning Activity** | **Evidence of Student Understanding** |
| **Engage:** what is a chemical reaction?-5min  **Explore:** in your groups, you will find sugar and sand and sugar and water. Mix the initial two substances separately and the other two likewise. Stir your mixtures. Talk about what you see-10min  **Explain:** what is different about the two mixtures? In which one can we claim a chemical reaction?-5min  **Elaborate:** explain the chemical change in the reaction**-** 2 [Na](http://en.wikipedia.org/wiki/Sodium)(s) + 2 [HCl](http://en.wikipedia.org/wiki/Hydrogen_chloride)[(aq)](http://en.wikipedia.org/wiki/(aq)) → 2 [NaCl](http://en.wikipedia.org/wiki/Sodium_chloride)(aq) + H2(g)-10min  **Evaluate:** <http://www.youtube.com/watch?v=Mx5JJWI2aaw>  The above clip shows the reaction between sodium and chlorine. What features convince you that there is a chemical change?-5min  **Wrap up:** 10min | 1. Students will have a clear understanding of when do we say a chemical reaction occurred and to interpret the results. | Students will work in pairs to explain the difference between an addition and decomposition reaction that I will give them. ELL’s may use their dictionaries that explain English concepts and may also communicate in their native languages while watching the video clips. Total time=50min. | 1. When they give me examples. 2. When they talk about changes that occurred. 3. They will describe a chemical reaction. 4. They will describe an observable chemical change based on the new products. 5. They will describe the chemical change based on what they observe with any f their senses. |

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| **Day6** | | | |
| **Phase of the lesson** | **Goal for the Activity** | **Description of Learning Activity** | **Evidence of Student Understanding** |
| **Engage:** what is a precipitation reaction? What is a precipitate?-10min  **Explore:** in the reaction- AgNO3 + NaCl → AgCl + NaNO3 –present the reaction practically and explain the results (MSDS)-15min  **Explain:** without knowing the names of the reacted substances, how could you tell if the reaction is a precipitation if you could only observe its product(s)?-5min  **Elaborate:** write the ionic equation for the reaction in the explore part. What is its net ionic equation after all the spectator ions have been eliminated?-discuss-10min  **Evaluate:** what information does the net ionic equation depict about the precipitation reactions?-whole class discussion-10min  **Wrap up:** 5min | 1. Students will be able to identify precipitation reactions. 2. Students will be able to represent precipitation reactions in ionic form. | Before they could even start the chemical reaction, the MSDS will be read to them. Students will be given a list of 2 precipitation reactions where they have to identify the precipitates and represent the reactions in ionic form- individual task. Total time of the lesson=1hr | 1. They will give me examples from the reactions they have seen. 2. Necessary observation of the chemical reaction. 3. Correct definition of the precipitation reaction. 4. Based on their answers. 5. Based on careful analysis of the answer. |

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| **Day 7** | | | |
| **Phase of the lesson** | **Goal for the Activity** | **Description of Learning Activity** | **Evidence of Student Understanding** |
| **Engage:** what is an acid and what the base?-10min  **Explore:** in the reaction,  http://www.iun.edu/~cpanhd/C101webnotes/chemical%20reactions/images/acid_base_rxn.jpg  With reasons, name the acid and base-10min  **Explain:** explain using Lowry Bronsted theory, which are acids and which the bases. HCl + NaHCO3 => NaCl + H2CO3. Which instrument can we use to identify the acid as well as the base? (I will watch them while they are doing it)-10min  **Elaborate:** write an equation explaining what happens when HCl is mixed with water. Repeat with NaOH. What is consistent in the two equations?-15min  **Evaluate:** can you name some properties of acids as well as for bases?-10min  **Wrap up:** 10min | 1. Students will be able to identify acids and bases in chemical reactions. 2. Students will explore some chemical properties of acids and bases. | Students will work individually on an activity that requires them to select some acid-base reactions from the list of various chemical reactions. Total time=60min | 1. Understanding of a pH scale learnt in previous grades. 2. Understanding of the role of H+ and OH- ions. 3. Understanding of the theory named. 4. Based on their answers. 5. Based on the learned info and open ended answers. |

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| **Day 8** | | | |
| **Phase of the lesson** | **Goal for the Activity** | **Description of Learning Activity** | **Evidence of Student Understanding** |
| **Engage:** can you define a single and a double replacement reaction?-5min  **Explore:**  **2 Al + 3 CuCl2 --> 2 AlCl3 + 3 Cudoublereplaceimage**  Observe these chemical reactions and label which is a single and which the double replacement. You are provided with the reactants, reach for your lockers and do the above reactions practically and write down some observations. MSDS is read first-25min  **Explain:** what observations you made are exclusive to these chemical reactions?-5min  **Elaborate:** with reasons, label which are single and which the double replacement reactions.   * Cl2 + NaBr rtarrow.gif (850 bytes)NaCl + Br2 * Mg + HCl rtarrow.gif (850 bytes)MgCl2 + H2 * AgNO3(aq) + KCl(aq) ‑‑‑‑> AgCl(s) + KNO3(aq) * Cu + 2AgNO3 → 2Ag + Cu(NO3)2 * NaNO3(aq) + KCl(aq) ‑‑‑‑> NaCl(aq) + KNO3(aq)   -5min  <http://dl.clackamas.edu/ch104-04/double.htm>  **Evaluate:** can you think of some examples of both single and double replacement reactions?-10min.  **Wrap up:** 5min. | 1. Students will differentiate practically between a single and double replacement reaction. 2. They will also be able to name chemical reactions. | Students have a solubility table attached to their workbooks. They will be given an activity that requires them to name chemical reactions. In the other part, they will be given chemical equations in words and required to write it symbolically. Time=60min | 1. Understanding of the word ‘replacement’. 2. Careful observations. 3. Test for certain elements and solubility rule. 4. Own answers. 5. Correct answers. |

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| **Day 9** | | | |
| **Phase of the lesson** | **Goal for the Activity** | **Description of Learning Activity** | **Evidence of Student Understanding** |
| **Engage:** what is a decomposition reaction? Combustion? Misconceptions are addressed since learners may think of decomposition as a biological term-6min.  **Explore:** study this chemical reaction:  2 H2O ---> 2 H2 + O2 how does it differ from a combination reaction?  What makes the reaction: C10H8 + 12 O2 ---> 10 CO2 + 4 H2O  a combustion? Explain-9min  **Explain:** which test can we use to prove the name of these chemical reactions? Before you do it practically, check how it is done in your chem. book and MSDS .-20min  **Elaborate:** how does the reaction: 2 Mg(*s)* + O2 (*g)* --> 2 MgO(*s)* differ from most combustion reactions?-5min  **Evaluate:** List what type the following reactions are (quiz):   |  | | --- | | 1:   2 Al2O3   —>  4 Al  +  3 O2 | | 2:   Mg  +  2 HNO3  —>  Mg(NO3)2  +  H2 | | 3:   2 K  +  Cl2  —>  2 KCl | | 4:   Ba(OH)2  +  2 HCl  —>  BaCl2  +  2 H2O | | 5:   CaI2  +  2 Li  —>  2 LiI  +  Ca | | 6:   Cu  +  2 AgNO3  —>  2 Ag  +  Cu(NO3)2 | | 7:   PbSO4  +  2 NaF  —>  PbF2  +  Na2SO4 | | 8:   MgCO3  —>  MgO  +  CO2 | | 9:   2 Zn  +  O2  —>  2 ZnO | | 10:   FePO4  +  3 NaOH  —>  Fe(OH)3  +  Na3PO4 | | 11:   2 Na  +  2 H2O  —>  2 NaOH  +  H2 | | 12:   2 Na3PO4  +  3 BaCl2  —>  Ba3(PO4)2  +  6 NaCl | | 13:   3 Mg(OH)2  +  2 H3PO4  —>  Mg3(PO4)2  +  6 H2O | | 14:   2 KClO3  —>  2 KCl  +  3 O2 | | 15:   4 K  +  O2  —>  2 K2O |   Please do not forget to substantiate your responses.  <http://mysite.verizon.net/redslime/ChPh/Quiz/compounds/compound3a.htm>  (correct answer only)  **Wrap up:** 5min | 1. Students will understand difference between various chemical reactions. 2. Students recognize practical ways of detecting some chemicals, compounds or elements. | Students will be working in the lab to carry out some reactions they will be taught about. I will give them an individually completed quiz in which they will be identifying all chemical reactions we have done as an overall reflection on the unit. Total time=60min | 1. They will give me examples. 2. Best observations made. 3. They will carry out necessary tests. 4. Careful observation. They will have to see carefully that there is no organic compound and give further clarity. 5. Based on their answers. |

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| **Day 10** | | | |
| **Phase of the lesson** | **Goal for the Activity** | **Description of Learning Activity** | **Evidence of Student Understanding** |
| **Engage:** what is a concentration of a solution? (misconceptions addressed)-5min.  **Explore:** follow the following titration procedure (MSDS is read): <http://docs.google.com/viewer?a=v&q=cache:VV8IAXqVheMJ:wikieducator.org/images/5/58/H2SO4-NaOH_Titration.pdf+titration+of+sodium+hydroxide+procedure&hl=en&gl=us&pid=bl&srcid=ADGEESh_O_oJGF6YJWOqV0C0XWf0kR4Q8F8J4EzQ8f93ICxEV10-v5Idy7vmtWGv4vHBjJpL1O0paopPmkJG3iqoZtiOVln9CaxxK6cDbHhOlxTIRQZwvd8Qyb8l2ATp05uhSWHoq2ff&sig=AHIEtbRtZ9DeM0X7xtj4yaq_xyD_sLH_NQ>  Write down your observations and notes-25min. Students will be assisted to demonstrate a skill of practical work.  **Explain:** referencing the experiment you have done, how could you define titration?-5min  **Elaborate:**   * If it takes 54 mL of 0.1 M NaOH to neutralize 125 mL of an HCl solution, what is the concentration of the HCl? * If it takes 25 mL of 0.05 M HCl to neutralize 345 mL of NaOH solution, what is the concentration of the NaOH solution? -10min   **Evaluate:** Can you explain the importance of stoichiometry and practical work from what we have been doing. In groups of 5, reflect in no more than 2 typed pages, Times New Roman, 12pt (20points). If you are not done by today, save your work and you will continue with it in class tomorrow.  **Wrap up:** 5min | 1. Learners will understand the importance of experimental data/ evidence to prove theory. 2. Learners will learn how to do titrations in lab. 3. Learners will learn how to use the dilution formula to calculate concentration of a solute. | Students will be given problems in which they will have to write equations and know their stoichiometry work and the application of the dilution formula to calculate the concentration of certain substances. Time= 60min. | 1. Understanding comes from their responses. 2. Careful observations and conclusions made. 3. Understanding comes from the practical they have conducted. 4. Based on their answers. 5. Based on their reflections. |

**Rubric:**

This is a formal assessment which will enter 5% into students’ portfolios.

1. Clear understanding and application of the content learned in class.
2. Backing practical analysis evidenced with some observations made in certain activities.

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| 1. Work is clear and has good examples.   (8-10points) | Work is clear but has least examples or is not substantiated.  (5-7points) | Work contains isolated facts with no examples or has irrelevant examples.  (0-4points) |
| 1. Practical evidence that show the importance of stoichiometry.   (8-10points) | Some of the practical evidence is not relevant to the facts.  (5-7points) | Work does not show practical evidence done in class or proof of relevant phenomena.  (0-4points) |

**N.B.** Plagiarism of work from the internet is punishable. All members must sign and declare their contribution. Good luck!